ARTIFICIAL RIPENING A STRATEGY OF DEGREENING FRUITS

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Summary

Artificial ripening can be used commercially for the climacteric fruits. This has made it possible for tropical fruits such as mangoes and bananas to be harvested green and shipped to distant markets, where they are ripened under controlled conditions, Natural ethylene production by fruits can cause problems in storage facilities. Flowers, in particular, are easily damaged by very small amounts of the gas. Ethylene destroys the green colour of plants, so lettuce and other vegetables marketed in the mature green but unripe state will be damaged if put into storage with ripening fruit; Ethylene production is increased when fruits are injured or attacked by moulds causing decay. This can start the ripening process and result in early ripening of climacteric fruit during transport. All produce should be handled with care to avoid injuries leading to decay. Nowadays artificial ripening is adopted more frequently as degreening is economically viable only for high-value export or domestic markets.

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Introduction[1]

Definition

Ripening is a process in fruits that causes them to become more edible. In general, a fruit becomes sweeter, less green, and softer as it ripens. However the acidity as well as sweetness rises during ripening, but the fruit still tastes sweeter regardless. Ripening is a continuous process and there is no single point of time when a fruit can be universally declared as "ripe". Anatomically, fruits are swollen ovaries that may also contain associated flower parts. Initially, fruits enlarge through cell division and then by increasing cell volume. The embryo matures, the seed accumulates storage products and loses water—which is the stage when the fruit begins to ripen. The carbohydrate, protein and lipid in the fruit undergo conversion, causing changes in texture, colour, taste and aroma.

Ethylene a simple hydrocarbon gas that ripening fruits make, and shed into the atmosphere, initiates the entire ripening process. This ethylene signal causes new enzymes to be made in the fruit and these enzymes, catalyses reactions to alter the characteristics of the fruit. Chlorophyll is broken down and new pigments are made so that the fruit skin changes colour from green to red, yellow, etc. Acids are broken down so that the fruit changes from sour to neutral. The degradation of starch by amylase produces sugar. This reduces the mealy quality of the fruit and increases sweetness and juiciness. The breakdown of pectin between the fruit cells unglues them so they can slip past each other. That results in a softer fruit. The enzymes also break down large organic molecules into smaller ones that evaporate into the air—which we detect as aroma.

Need of artificial ripening[2]

Ethylene gas is produced in most plant tissues and is known to be an important factor in starting off the ripening of fruits. Ethylene is important in fresh produce marketing because: It can be used commercially for the artificial ripening of the climacteric fruits. This has made it possible for tropical fruits such as mangoes and bananas to be harvested green and shipped to distant markets, where they are ripened under controlled conditions; Natural ethylene production by fruits can cause problems in storage facilities. Flowers, in particular, are easily damaged by very small amounts of the gas. Ethylene destroys the green colour of plants, so lettuce and other vegetables marketed in the mature green but unripe state will be damaged if put into storage with ripening fruit; Ethylene production is increased when fruits are injured or attacked by moulds causing decay. This can start the ripening process and result in early ripening of climacteric fruit during transport. All produce should be handled with care to avoid injuries leading to decay. Damaged or decaying product should not be stored; Citrus fruit grown in tropical areas remains green after becoming fully ripe on the tree. It develops full colour after harvest only if "degreened" by the use of (manufactured) ethylene gas. The gas concentration, temperature, humidity and ventilation have to be carefully controlled in specialized rooms, so degreening is economically viable only for high-value export or domestic markets. In most tropical countries fully ripe green citrus fruit is acceptable to local populations.

Ripening agents[3]

Ripening agents speed up the ripening process.

Table no.1: Ripening agents

Sr. No.	Ripening agents	Description
1.	Ethylene gas	They allow many fruits to be picked prior to full ripening, which is useful since ripened fruits do not ship well. For example, bananas are picked when green and artificially ripened after shipment by being gassed with ethylene.

2.	Acetylene	A similar method used in parts of Asia was to cover a bed of slightly green-harvested mango and a few small open containers of clumps of calcium carbide with a plastic covering. The moisture in the air reacted with the calcium carbide to release the gas acetylene, which apparently has the same effect as ethylene. Calcium carbide is used for ripening the fruit artificially in some countries. Industrial-grade calcium carbide may contain traces of arsenic and phosphorus and thus use of this chemical for this purpose is illegal in most countries. Calcium carbide once dissolved in water produces acetylene which acts as an artificial ripening agent.
3.	Carbon dioxide	Covered fruit ripening bowls are commercially available to increase fruit ripening. The manufacturers claim the bowls increase ethylene and carbon dioxide gasses around the fruit which promote ripening.

Ripening delaying[4]

SmartFresh is a technology useful to maintain fresh-picked quality of whole fruits and vegetables. 1-Methylcyclopropene (1-MCP 0.14%) works with the ripening process to dramatically slow down ethylene production and prevent over-ripening and problems associated with ageing.

Ripening indicators[5]

Iodine (I) can be used to check if the fruit is ripening or rotting by showing whether starch in the fruit has turned into sugar. For example, in an apple that has rotted (not bruised, just rotted) a drop of iodine on a slightly rotten part (not skin) will turn a dark blue ,or black color if there is starch there. If it stays yellow, then most of the starch did turn into sugar.

Brix/acid ratio[6]:

This is one of the first indices used as a measure of maturity. It is simply the quotient of the percent total titratable acids divided into the Brix. Alone it is a poor measure of maturity, since a great variety of Brix and acid readings would produce the same ratio. A fruit low in acid would produce a high ratio; however that low acid fruit is insipid in taste, especially in oranges. A change in acid affects the ratio more than does a change in Brix.

1.**Ripening of Tomatoes[7]**

Tomatoes are often picked unripe (and thus colored green) and ripened in storage with ethylene. Unripe tomatoes are firm. As they ripen they soften until reaching the ripe state where they are red or orange in color and slightly soft to the touch. Ethylene is a hydrocarbon gas produced by many fruits that acts as the molecular cue to begin the ripening process. Tomatoes ripened in this way tend to keep longer but have poorer flavor and a mealier, starchier texture than tomatoes ripened on the plant.

They may be recognized by their color, which is more pink or orange than the other ripe tomatoes' deep red, depending on variety. Recently, stores have begun selling "tomatoes on the vine", which are determinate varieties that are ripened or harvested with the fruits still connected to a piece of vine. These tend to have more flavor than artificially ripened tomatoes (at a price premium), but still may not be the equal of local garden produce. Slow-ripening cultivars of tomato have been developed by crossing a non-ripening cultivar with ordinary tomato cultivars. Cultivars were selected whose fruits have a long shelf life and at least reasonable flavor. At home, fully ripe tomatoes can be stored in the refrigerator, but are best kept at room temperature. Tomatoes stored in the refrigerator tend to lose flavor but will still be edible; thus the "Never Refrigerate" stickers sometimes placed on tomatoes in supermarkets.

Factors affecting ripening and quality of mature-green tomatoes

Effect of post harvest conditions and treatments, including temperatures, ethephon and ethylene treatments as well as maturity of tomatoes M-1 to M-4 were studied in relation to ripening and quality change after harvest. The lowest concentration of ethylene tested, 0,3 ppm, was effective in reducing time from mature-green to breaker, nearly in half. Maximum response of mature-green fruits (M-2) to ethylene at concentration of 100 ppm was achieved in 4 days, although this was not significantly different from 2 days. Each maturity class had a significantly shorter ripening time than the previous class. Holding for 1 day at 30°C did not significantly affect the response to ethylene. Ethereal treatments gave ripening results essentially the same as ethylene treatments.

2. Ripening of Banana [8,9]

Bananas are harvested in the green stage and ripening is controlled by temperature and ethylene. Because of long distance shipment, proper harvest time and ripening procedures is the key factor in the commercial industry. Ripening bananas may be held 56 to 60°F; lower temperatures cause chilling injury and discoloration of the skin. If kept at low humidity fruit gets mealy at any temperature.

Ripening schedule:

Temperature (^{0} F)

1^{st} day	2^{nd} day	3^{rd} day	4^{th} day	5^{th} day	6^{th} day

Ripe bananas require 85 to 95% relative humidity (RH); green bananas require 100% RH Ethylene treatments induce ripening. Ripening room temperature raised to 65°F and then ethylene is released. A cubic ft. of ethylene in 1000 ft. of space is 100 ppm. Usually two to three applications at 24 hr intervals.

3. Ripening Scots pine (*Pinus sylvestris* L.) seeds and Effect of disturbed photoperiod on the surface structures of ripening Scots pine (Pinus *sylvestris* L.) seeds[10]

The role of disturbed photoperiod on the developing surface layers of ripening Scots pine (*Pinus sylvestris* L.) seeds was studied from August 14 to October 30. The embryo sizes of both the light-treated and the control seeds were examined by the X-ray method prior to germination tests. The anatomical details of resin-embedded seeds were examined by fluorescence and light microscopy. The timing of the ripening process of the surface structures was described and documented. The greatest anatomical changes in the ripening seeds occurred in the sarcotesta and in the nuclear layers. Maturation of the surface structures was essentially slower than could have been interpreted by the size of the embryo and responded clearly to the disturbance of photoperiod. Accumulation of phenolic substances and degeneration of cells, particularly at the chalazas region, advanced faster in the light-treated than in the control seeds up to mid-September. The ripening effect of the altered photoperiod diminished, however, after mid-September. This was also confirmed by the brown colour of the seed coat getting darker only in the control seeds at the end of the test period. Consequently, fully ripe structures were first found about a fortnight earlier in the control than in the light-treated seeds. The coincidental advancement of the anatomical potential examined by the X-ray method supported the role of the surface structures on the anatomical maturity of pine seeds and the timing of cone collecting.

Side effects of ripening agents

Calcium carbide[11]

Many techniques are employed to ripen mature fruits; the most commonly used agent is calcium carbide. It has carcinogenic properties and is used in gas welding for steel goods. This method is being used in most of the climacteric fruits (fruits which are picked when mature, and ripened only after they are picked) like mangoes and bananas. No wonder, health freaks that go on a fruit diet to keep fit, often end up with mouth ulcers, gastric irritation or even food poisoning. Calcium carbide, popularly known as *masala*, is used extensively in mangoes, bananas and papayas, and sometimes in apples and plums. "Being cheap (one kg of this chemical costs Rs 25-30, which can ripen 10 tonnes of fruit), it is indiscriminately used by the traders in preference to other recommended practices of inducing ripening like dipping fruits in a solution of ethephon, or exposure of fruits to ethylene gas," says Dr B.V.C Mahajan, Horticulturist, Punjab Horticulture Post-Harvest Technology Centre, Ludhiana.

Process of ripening

Using calcium carbide is also a less cumbersome procedure. All that a trader has to do is wrap a small quantity of calcium carbide in a paper packet, and keep this packet near a pile of bananas, or a box of mangoes or other fruits. This box is kept in a closed space for one or two days. As chemical reaction takes place, because of moisture content in the fruit, heat and acetylene gas are produced, which hastens the ripening process. In case of bananas, the ripening starts within 24 to 48 hours, depending on the ambient temperature and when the fruits yield to slight finger pressure, they are kept under ice slabs for lowering temperature and the colour develops. However, fruit ripened with calcium carbide are overly soft and less tasty. They also have a shorter shelf life. "Not only is it harmful to the consumers, but it is also dangerous to handle calcium carbide and

acetylene because of their explosive properties. The chemical is so reactive that it causes blisters, if it is touched unknowingly with wet hands," says Dr Mahajan.

2. Allergy due to Artificial ripening of strawberry[12, 13]

Some people experience an anaphylactoid reaction to the consumption of strawberries. The most common form of this reaction is oral allergy syndrome, but symptoms may also mimic hay fever or include dermatitis or hives, and in severe cases may cause breathing problems. Some research suggests that the allergen may be tied to a protein involved in the ripening of fruits which was named Fra a1 (Fragaria allergen1). Homologous proteins are found in birch and apple, which suggests that people may develop cross-reactivity to all three species. White-fruited strawberry cultivars, lacking Fra a1, may be an option for strawberry allergy sufferers. Since they lack a protein necessary for normal ripening, they do not produce the flavonoids that turn the mature berries of other cultivars red. They ripen but remain white, pale yellow or "golden", appearing like immature berries; this also has the advantage of making them less attractive to birds. A virtually allergen-free cultivar named 'Sofar' is available.

Action against artificial ripening

Incidentally, this practice is banned under the Prevention of Food Adulteration Act, and violators are liable to undergo a six-month imprisonment and pay a fine of Rs 1,000. But there are hardly any cases where the traders or retailers have been booked for accelerating ripening by the use of harmful chemicals.

Preventive measures

Wash the fruits thoroughly before consuming. Keep these under running water for a few minutes, so that the chemicals are washed away. Do not buy fruits when these arrive in the mandis before the due period. You can be almost sure that they are artificially ripened for better marketing and earning profits. While eating mangoes and apples, cut the fruit into pieces, rather than consuming directly. What looks attractive outside may not be good for health. Fruits that have a uniform colour, for example, a bunch of bananas having a uniform colour, are more likely to have been artificially ripened.

Conclusion

The present review is an attempt to correlate the methods of artificial ripening. Various hazards of it associated with it. The principles of artificial ripening are mainly used for degreening of the tropical fruits especially citrus fruits. As it is a viable economical method of preservation of fruits and proved to be an effective in delaying decaying of Fruits.The side effects of using the artificial ripening agents can be minimized by limited use of this agents. So the probable health hazards can be avoided.

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